



## **Limited Visual Dam Safety Inspection Summary Report**

**MA-046**

**Waikamoi Dam Number 2**

**Maui, Hawaii**

**Prepared by:**

**U.S. ARMY CORPS OF ENGINEERS  
HONOLULU ENGINEER DISTRICT**

**STATE OF HAWAII  
DEPARTMENT OF LAND AND NATURAL RESOURCES**

**May 2006**

Limited Visual Dam Safety Inspection Conducted on: 05 April 2006

**I. Purpose**

Due to disaster occurrences of periodic heavy rains and flooding, which has caused extensive damage to property and loss of lives, the Governor has issued a State of Emergency Proclamation extending from February 20, 2006 to April 9, 2006. In light of the tragic failure of the Kaloko dam on Kauai and the continued forecast of heavy rains, emergency inspections of all regulated dams in all counties are being undertaken.

These inspections are for the purpose of determining if any of the regulated dams and reservoirs in the City and County of Honolulu, Maui County or Hawaii County, are suspect for immediate concern to the downstream area under the prolonged conditions of heavy rain showers.

**II. Authority**

Inspections are authorized under the Hawaii Dam Safety Act of 1987, Chapter 179D "Dams and Reservoirs" of Hawaii Revised Statutes, and Title 13, Subtitle 7, Chapter 190, "Dams and Reservoirs" of the Hawaii Administrative Rules.

These inspections are being conducted under joint agreements of the U.S. Army Corps of Engineers (USACE), the U.S. Department of Agriculture Natural Resources Conservation Service (NRCS), and the State of Hawaii. The Memorandum of Agreement with the U.S. Army Corps of Engineers is entered into pursuant to 10 U.S.C. § 3036(d)(2), and the Intergovernmental Cooperation Act (31 U.S.C. §6505), and established via support agreement number DL-06-01.

**III. Scope**

Visual inspection will be made on parts of the embankment and appurtenant works readily available and visible for inspection by the inspection team at the time of the inspection. Such parts and appurtenant works would include the upstream slope, crest, downstream slope, abutments and toes, outlet works, and spillway.

On the date of this limited visual inspection, there may appear to be no immediate threat to the safety of the dam, however no assurance can be made regarding the dam's condition after this date. Subsequent adverse weather and other factors may affect the dam's condition.

**IV. Limitations of Findings and Recommendations**

The inspection is based only on visible features/areas of the dam on the day of inspection. The inspection does not entail detailed stability, hydrologic, hydraulic, or seismic investigations. This inspection is not a formal phase I or phase II dam safety inspection and does not include a review or evaluation from each specialist of an inspection team, such as a geologists, civil, geotechnical, structural, or hydraulics engineer. The owner should verify the findings of this report and take corrective actions. The owner may submit to the State alternative corrective actions that are certified by a licensed professional engineer in the State of Hawaii experienced in the design and construction of dams. This inspection does not relieve the owner/operator from their responsibility to conduct routine inspections, maintenance, repairs, modifications, monitoring, documentation, and/or investigative studies.

**V. Inspection Team**

<u>Organization</u>	<u>Name /Title</u>
U.S. Army Corps of Engineers	Troy O'Neal, P.E. Geotechnical Engineer
State of Hawaii, Dept. of Land and Natural Resources	Gordon Chong Engineering Division

**VI. Owner's Representatives Present**

Maui County, Department of Water Supply	Paul Seitz
Maui County, Department of Water Supply	Walter Hager

**VII. Summary Report Team**

<u>Organization</u>	<u>Name</u>
U.S. Army Corps of Engineers	Derek Chow Bill Empson
State of Hawaii, Dept. of Land and Natural Resources	Denise Manuel Edwin Matsuda

**VIII. Dam Type**

The dam appeared to be a concrete arch dam.

# IX. Dam Classification

The current hazard classification of this dam is: Low

Hazard Potential Classification based on the following:

Category	Loss of Life	Economic Loss
Low	None Expected	Minimal (undeveloped to occasional structures or agriculture)
Significant	Few (No Urban development and no more than a small number of inhabitable structures)	Appreciable (Notable agriculture, industry or structures)
High	More than a few	Extensive community, industry or agriculture.

Based on inventoried storage and height (roughly 60ft) data, the size classification of the dam is: Most likely intermediate but insufficient information is available to inspectors to make a determination.

Size Classification based on the following:

Category	Storage (Acre-Feet)	Height (feet)
Small	< 1000	< 40
Intermediate	> 1000 and < 50,000	> 40 and < 100
Large	> 50,000	> 100

# X. Summary of Inspection:

Condition Rating Criteria: The conditional terms in this report are used to generally describe the conditions below. Inspections, monitoring, and additional investigations are considered to be incidental to all condition ratings.

Satisfactory	Expected to fulfill intended function.
Fair	Expected to fulfill intended function, but maintenance is recommended.
Poor	May not fulfill intended function; maintenance or repairs are necessary.
Unsatisfactory	Is not expected to fulfill intended function; repair, replacement, or modification is necessary.
Unknown	Not visible, not accessible, not inspected, or unable to determine the condition rating based on the observation taken.

**A. General appearance:**

The dam consists of a concrete arch type construction completed in 1956. The dam is roughly 80 feet across at the top and narrows slightly toward the bottom the match the rock valley walls. A primary uncontrolled concrete (flip bucket type) spillway about 15 feet wide is located in the middle of the concrete dam. Secondary spillway notches on either side (two each side) were observed. The dam is approximately 60 feet tall and appears to have a significant drainage area.

Findings and Corrective Actions:

- a. The Owner shall maintain documentations including Construction plans, specifications, improvements, modifications, Operations and Maintenance Manuals and routine inspection logs for this dam facility.
- b. An EAP is recommended for all dams regardless of hazard class. Submit EAP if developed for the facility.
- c. Routine inspection logs were not inspected.
- d. Dam owners shall provide for routine inspection of the dam.
- e. The dam did not appear to be maintained on a regular basis.
- f. There is no vehicular access to the dam site. Operational and emergency plans need to reflect this deficiency or access provided.
- g. Access to dam is questionable during severe weather conditions and/or spillway overflows. Operational plans and emergency plans need to reflect this deficiency or access provided.
- h. Submit current Operations and Maintenance Manual or Procedures for this dam / reservoir facility.
- i. Submit Site or Facility Map of this Dam which identifies the location of major features including outlet works controls and conduits.
- j. Emergency Alarms / Monitors: There were no alarms or monitors observed on this reservoir.
- k. Power / Communication: There were no communication systems observed on this reservoir.

**B. Access / Security:**

Access to the dam was accomplished via a County roadway and extensive four wheel driving. A short hike was also required to reach the site.

Security issues. Access to the dam is generally unrestricted though passage through 3 gates was required to get to the site.

**C. Intake Works: (Unknown)**

There were no inlet works. Water impounded from upstream drainage basin valley.

Findings and Corrective Actions:

- a. The intake works were not inspected.

**D. Reservoir: (Fair)**

The reservoir was filled and a slight flow was occurring over the flip bucket type spillway was noted during the inspection. A staff gage did not exist. Typically the reservoir is operated seasonally.

Findings and Corrective Actions:

- a. The reservoir appeared to be in fair to poor condition and requires corrective action. Seepage noted at right abutments that needs to be evaluated further.
- b. A staff gage was not observed at the reservoir. Provide some method of quantifying the water level within the reservoir.

**E. Upstream Slope: (Satisfactory)**

The upstream slope consisted of a vertical concrete arch dam that is approximately 60 feet tall.

Findings and Corrective Actions:

- a. The upstream slope was not inspected due to being underwater (vertical concrete arched dam).

**F. Crest: (Satisfactory)**

The dam crest was approximately 18 inches wide. A walking platform was built on top of the crest to allow access to the outlet works valve control on the crest.

Findings and Corrective Actions:

- a. The dam crest appeared to be in satisfactory condition, no corrective actions are required at this time.
- b. Access along the crest was satisfactory on foot.

**G. Downstream Slope: (Satisfactory)**

The downstream slope was nearly vertical. It is estimated to be 20 V on 1 H slope. The downstream slope had no vegetation. No erosion was observed on the downstream slope. Sinkholes were not observed on the downstream slope. Seepage was not observed along the vertical lift joints of the concrete arch dam downstream slope.

Findings and Corrective Actions:

- a. The downstream slope appeared to be in satisfactory condition, no corrective actions are required at this time.
- b. The arch dam was built prior to routine consideration of uplift seepage forces. Dam stability should be evaluated. Note conventional 2D limit equilibrium analysis will not capture critical stabilizing forces of the arch dam at ends.

**H. Abutments / Toe: (Fair)**

Seepage was observed at the right abutment toe, and it was a constant flow of less than 1 GPM. The seep was clear and appears to have been flowing for a long time based on the staining of rock at seep.

Findings and Corrective Actions:

- a. The abutments/toe appeared to be in fair to poor condition and requires corrective action. The seep should be further evaluated.
- b. Seepage was observed. Monitor and conduct further investigation to locate the source of water and extent of any possible hazardous or developing condition.

**I. Outlet Works: (Fair)**

The outlet works are complex for the project site. At the main concrete arch dam, a control valve is located on the far crest and was reported to open a pipe of unknown size and type (likely DIP) that existed to daylight just downstream of the right abutment. 200 yards downstream an abandoned diversion ditch was noted that connected into a spillway works that consisted of a 16" by 30" concrete culvert that was flowing at the time of inspection. Water was impounded in this area from a diversion dam called dam #1 by the operator. This dam was roughly 12 feet in height and was made of concrete and appears to have been raised 3 feet with grouted stone in the past. Additionally, water is impounded in this area from a wooden flume collection system from the Halpuaena gouge.

Findings and Corrective Actions:

- a. The outlet works were not inspected. Access was difficult, but appeared to be working as designed.

**J. Spillway: (Satisfactory)**

This spillway consisted of a concrete channel flip bucket type that is very steep, and is approximately 15 feet. The spillway approach was clear. There was no erosion observed near the spillway.

Findings and Corrective Actions:

- a. The Spillway appeared to be in satisfactory condition, no corrective actions are required at this time.

**K. Down Stream Channel: (Unknown)**

There is a well-defined downstream channel.

Findings and Corrective Actions:

- a. The downstream channel was not inspected.

Dam ID: MA-0046

Name: Waikamoi Dam No. 2

**XI. Additional Comments:**

Based on visual observations and discussion of operational procedures of the dam, there is no immediate threat to the safety of the dam at this time.

The arch dam was built prior to the routine consideration of uplift seepage forces. Dam stability should be evaluated based on current criteria.

Slight seep noted along the right abutment toe area. This seep should be monitored and reported if significant changes in flow occur.



## PHOTOGRAPHS

**MA-046 Waikamoi Reservoir**

## MA-046 Waikamoi Reservoir



046 View of Crest



## MA-046 Waikamoi Reservoir



046 View of Concrete Arch Dam with Flip Bucket Spillway



## MA-046 Waikamoi Reservoir



046 16 wide gated outlet structure adjacent to abandon diversion culvert.



## MA-046 Waikamoi Reservoir



046 View of Diversion Dam (#1) Downstream of Dam #2.



## MA-046 Waikamoi Reservoir



046 Outlet Collection Area Right Side



## MA-046 Waikamoi Reservoir



046 Diversion Dam downstream of arch dam. (Dam #1)



## MA-046 Waikamoi Reservoir



046 Slight seep (staining) along right abutment toe.



## MA-046 Waikamoi Reservoir



046 US View from Outlet Pool - View of arch dam from DS

## **FIELD INSPECTION SHEETS**

Dam ID: MA-0046  
WAIKAMOI DAM NO. 2

Vulnerability Index:  
Extreme High Moderate Low  
1 2 3 4

Inspection No: \_\_\_\_\_  
Date: 4/5/06

STATE OF HAWAII - DLNR  
DAM SAFETY INSPECTION SHEET

Inspection Type: Visual Dam Safety Inspection

**Persons Present**

**Affiliation**

**Phone Number**

TROY O'NEAL  
GORDON CHONG  
PAUL SEITZ

US Army Corps of Engineers  
DLNR  
MAUI CO. DEPT. OF WATER

Weather Condition: ☐ Rain previous day ☐ Rainy ☐ Drizzle / Mist ☐ Cloudy/Overcast ☒ Partly Cloudy ☐ Sunny ☐ Dry  
Comments: COOL

**1. General:** (Information currently on file, update as required)

Dam/Res. Name WAIKAMOI DAM NO. 2  
Owner Maui County, Department of Water Supply (C037)  
Owner Contact Mr. Walter Hager Owner Ph. \_\_\_\_\_  
Lessee \_\_\_\_\_ Lessee Ph. \_\_\_\_\_  
O & M Contractor \_\_\_\_\_ O & M Ph. \_\_\_\_\_  
Nearest Town KAILUA Latitude 20.81 ° (decimal)  
County MAUI Longitude 156.2333 ° (decimal)  
Tax Map Key(s) \_\_\_\_\_

Dam Status A: Hazard Potential L: Dam Size \_\_\_\_\_  
Year Completed 1956 Dam Length 98 ft. Dam Height 60.35 ft.  
Normal Storage 32 ac.ft. Max. Storage 37 ac.ft. Max. Surface Area \_\_\_\_\_ ac.  
Drainage Area \_\_\_\_\_ mi. Spillway Type \_\_\_\_\_ Max. Spillway Q \_\_\_\_\_ cfs

Owner owns land under dam facility: \_\_\_\_\_  
Emergency Action Plan on file with the Department: NO  
Reports on file with the Department: None on file.

Dam ID: MA-0046

WAIKAMOI DAM NO. 2

Inspection No: \_\_\_\_\_

Date: 4/5/06

**2. Questions for Owner's Rep.:**

Yes No Unknown Comments

Construction Plans Available	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Site / Facility Map	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Operation & Maintenance Manual	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Emergency Action Plan	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Modifications / Improvements	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Conduct Routine Inspections	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	SEASONAL, HIGH RAIN EVENTS OR DRY PERIODS
Conduct Routine Maintenance	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Vehicle access to site	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/> Not accessible <input type="checkbox"/> With Standard car <input type="checkbox"/> Requires 4-Wheel Drive
Access during heavy rains	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/> Not accessible <input type="checkbox"/> With Standard car <input type="checkbox"/> Requires 4-Wheel Drive
Access when spillway is flowing	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/> Not accessible <input type="checkbox"/> With Standard car <input type="checkbox"/> Requires 4-Wheel Drive
Other Studies Conducted	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> Phase I <input type="checkbox"/> Phase II <input type="checkbox"/> Hydraulics <input type="checkbox"/> Stability <input type="checkbox"/> Hazard <input type="checkbox"/> Seismic <input type="checkbox"/> Other: _____
Incident History	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> Breached <input type="checkbox"/> Overtop <input type="checkbox"/> Slide <input type="checkbox"/> Down stream Flooding <input type="checkbox"/> Other: _____
Reservoir's Current Use	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> Sediment <input checked="" type="checkbox"/> Irrigation <input type="checkbox"/> Recreation <input type="checkbox"/> Flood Control <input type="checkbox"/> Drinking Water <input type="checkbox"/> Power Generation <input type="checkbox"/> Other: _____

**Findings and Corrective Actions:**

- ☒ a. The Owner shall maintain documentations including Construction plans, specifications, improvements, modifications, Operations and Maintenance Manuals and routine inspection logs for this dam facility.
- ☐ b. An Emergency Action Plan (EAP) is on file with the department, submit any updates as applicable.
- ☐ c. An EAP is required for High Hazard Dams. Submit an updated EAP for this facility.
- ☒ d. An EAP is recommended for all dams regardless of hazard class. Submit EAP if developed for the facility.
- ☐ e. Submit narrative and additional information detailing the improvements, modifications, and/or alterations at the dam site, unless covered by approved dam permit.
- ☒ f. Routine inspection logs were not inspected.
- ☒ g. Dam owners shall provide for routine inspection of the dam.
- ☒ h. The dam did not appear to be maintained on a regular basis.
- ☐ i. Access to site appears to be satisfactory.
- ☒ j. There is no vehicular access to the dam site. Operational and emergency plans need to reflect this deficiency or access provided.
- ☒ k. Access to dam is questionable during severe weather conditions and/or spillway overflows. Operational plans and emergency plans need to reflect this deficiency or access provided.
- ☐ l. Provide a detailed narrative of the incident, responses taken, and any damages incurred. Dam owners are required to promptly advise the department of any sudden or unprecedented flood or unusual or alarming circumstance or occurrences which may adversely affect the dam or reservoir.
- ☒ m. Submit current Operations and Maintenance Manual or Procedures for this dam / reservoir facility.
- ☒ n. Submit Site or Facility Map of this Dam which identifies the location of major features including outlet works controls and conduits.
- ☐ o. \_\_\_\_\_

**Additional Requirements:**

The following investigative study(s) are:

Required Recommended

- |                          |                                     |  |
|--------------------------|-------------------------------------|--|
| <input type="checkbox"/> | <input checked="" type="checkbox"/> | Phase I Study  |
| <input type="checkbox"/> | <input type="checkbox"/>            | Phase II Study (Including <input type="checkbox"/> Seepage <input type="checkbox"/> Hydrology/Hydraulics <input type="checkbox"/> EAP) |
| <input type="checkbox"/> | <input type="checkbox"/>            | Hydrology and Hydraulics (including Probable Maximum Flood and spillway capacity)  |
| <input type="checkbox"/> | <input checked="" type="checkbox"/> | Stability Analysis   |
| <input type="checkbox"/> | <input type="checkbox"/>            | Seismic Analysis   |
| <input type="checkbox"/> | <input type="checkbox"/>            | Hazard Classification  |
| <input type="checkbox"/> | <input type="checkbox"/>            | Other: _____   |



Dam ID: MA-0046

WAIKAMOI DAM NO. 2

Inspection No: \_\_\_\_\_

Date: 4/5/06

**Physical Dam Features:** (Check All Applicable. Provide description of Items Observed and/or Take Photos. Indicate photo # in description.)

**3. Reservoir:**

Level during inspection UNKNOWN ft per \_\_\_\_\_ (gage / other)

Normal Operating Level/Range UNKNOWN ft per \_\_\_\_\_ (gage / other)

Description: NO TRUE NORMAL RANGE, BASED ON WATER NEEDS AND SEASON

Typical Operation ☐ Spillway always flowing ☐ Kept within normal range ☐ Kept Empty ☐ Drained Daily ☒ Only filled by Storms

☒ Other: SPILLWAY DURING RAINY SEASON, PIPED DURING DRY SEASON

Sinkhole in Res.: ☐ # Observed: \_\_\_\_\_ Size: \_\_\_\_\_ by \_\_\_\_\_ in. Deep ☐ Not Visible ☒ None Observed

Description: \_\_\_\_\_

Staff Gage: Description: NONE

**Findings:**

- ☐ a. The reservoir was not inspected.
- ☐ b. The reservoir appeared to be in satisfactory condition, no corrective actions are required at this time.
- ☒ c. The reservoir appeared to be in fair to poor condition and requires corrective action. SEEPAGE NOTED @ RIGHT ABUTMENT THAT NEEDS TO BE EVALUATED FURTHER.
- ☐ d. The reservoir appeared to be in unsatisfactory condition, urgent corrective action is required.

**Corrective Actions:**

- ☐ e. The staff gage needs maintenance and/or repair. Description: \_\_\_\_\_
- ☒ f. A staff gage was not observed at the reservoir. Provide some method of quantifying the water level within the reservoir.
- ☐ g. A sinkhole was observed in the upstream reservoir. Conduct additional investigations and monitoring to identify the cause, risk and appropriate action.
- ☐ h. \_\_\_\_\_

**4. Intake Works Description:**

NO INLET WORKS. WATER IMPOUNDED FROM UPSTREAM DRAINAGE BASIN VALLEY.

☐ Number of Intakes \_\_\_\_\_

☐ Intake Culvert / Pipe

Size: \_\_\_\_\_ in. ☐ DIP ☐ Corrugated Metal ☐ PVC ☐ HDPE ☐ Concrete ☐ Other \_\_\_\_\_

Control: ☐ Gate ☐ Valve ☐ Flow can either be Shut off or Bypassed

From: ☐ Stream Diversion ☐ Pump ☐ Reservoir ☒ Other VALLEY BASIN

☐ Ditch / Flume

Dimension: \_\_\_\_\_ (Size x Depth) Shape \_\_\_\_\_

Surface: ☐ Dirt ☐ Wood ☐ Concrete ☐ Lined w/ \_\_\_\_\_

Control: ☐ Gate ☐ Valve ☐ Flow can either be Shut off or Bypassed

From: ☐ Stream Diversion ☐ Pump ☐ Reservoir ☐ Other \_\_\_\_\_

**Findings:**

- ☒ a. The intake works were not inspected.
- ☐ b. The intake works were not tested. N/A
- ☐ c. The intake works appeared to be in satisfactory condition, no corrective actions are required at this time.
- ☐ d. The intake works appeared to be in fair to poor condition and requires corrective action.
- ☐ e. The intake works appeared to be in unsatisfactory condition, urgent corrective action is required.

**Corrective Actions:**

- ☐ f. The intake works needs maintenance and/or repair. Description: \_\_\_\_\_
- ☐ g. \_\_\_\_\_

Dam ID: MA-0046  
WAIKAMOI DAM NO. 2

Inspection No: \_\_\_\_\_  
Date: 4/5/06

5. Upstream Slope: **VERTICAL CONCRETE ARCH DAM (#60 FT TALL)**  
(Typical Slope  $\pm$  \_\_\_\_\_) NEAR VERTICAL  
Slope Protection: ☐ None ☐ Dumped Rock ☐ Fitted Rip Rap ☐ Grouted Rip Rap ☐ Liner ☒ Other: CONCRETE  
☐ Defect in Protection: Description: \_\_\_\_\_  
Erosion: ☐ Loose soil w/ little vegetation ☐ Rut (<6") ☐ Gully (>6" deep) ☐ Not Visible ☒ None Observed  
Description: \_\_\_\_\_  
Cracks: ☐ Parallel with crest ☐ Perpendicular to crest ☐ Slide visible ☐ Not Visible ☒ None Observed  
Description: \_\_\_\_\_  
Sinkholes: ☐ # Observed: \_\_\_\_\_ Size: \_\_\_\_\_ and \_\_\_\_\_ Depth ☐ Not Visible ☒ None Observed  
Description: \_\_\_\_\_  
Vegetation: ☒ None ☐ Low Ground Cover ☐ Bushes or Tall Grass ☐ Trees # \_\_\_\_\_ ☐ <6" ☐ >6" & <20" ☐ >20"  
Description: \_\_\_\_\_

**Findings:**

- ☒ a. The upstream slope was not inspected. UNDERWATER - VERT. CONCRETE ARCH DAM.  
☐ b. The upstream slope appeared to be in satisfactory condition, no corrective actions are required at this time.  
☐ c. The upstream slope appeared to be in fair to poor condition and requires corrective action.  
☐ d. The upstream slope appeared to be in unsatisfactory condition and not expected to fulfill its intended function.  
Urgent corrective action is required.

**Corrective Actions:**

- ☐ e. Slope protection needs maintenance or repair. Description: \_\_\_\_\_  
☐ f. Rut and/or Gully erosion was observed on the slope, which requires maintenance and/or repair.  
Description: \_\_\_\_\_  
☐ g. A crack was observed on the slope, which requires further investigation to determine the underlining cause.  
Monitor the area and/or repair as required.  
☐ h. A sinkhole was observed on the slope, which requires further investigation to determine the underlining cause.  
Repair and monitor the area.  
☐ i. The upstream slope was not visible due to high grass and bush vegetation. Clear high vegetation and maintain low to enable easy visual inspection.  
☐ j. Tree(s) were observed on the dam embankment. Trees have been identified as the probably cause of piping failures, and can possibly cause sever damage to the embankment if they are uprooted during a high winds. Corrective action is required to remove the tree hazards from the dam. Acceptable remedies include removal of the tree and its root structure down to a 2" diameter and reconstructing the damaged embankment section. All repair work shall be accomplished as per the requirements of licensed geotechnical or structural engineer. Routinely monitor the damaged area for signs of settlement and seepage.  
☐ k. \_\_\_\_\_

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**6. Crest:**

Approximate Crest Width: 18"

Access: ☐ None ☒ Walking Path ☐ Roadway, Surface / Width / Usage: \_\_\_\_\_

Erosion: ☐ Loose soil w/ little vegetation ☐ Rut (<6") ☐ Gully (>6" deep) ☐ Not Visible ☒ None Observed

Description: \_\_\_\_\_

Cracks: ☐ Parallel with crest ☐ Perpendicular to crest ☐ Slide visible ☐ Not Visible ☒ None Observed

Description: \_\_\_\_\_

Sinkholes: ☐ \_\_\_\_\_ in. Wide x \_\_\_\_\_ in. Long x \_\_\_\_\_ in. Deep ☐ Not Visible ☒ None Observed

Description: \_\_\_\_\_

Vegetation: ☒ None ☐ Low Ground Cover ☐ Bushes or Tall Grass ☐ Trees # \_\_\_\_\_ ☐ <6" ☐ >6" & <20" ☐ >20"

Description: \_\_\_\_\_

**Findings:**

- ☐ a. The dam crest was not inspected.
- ☒ b. The dam crest appeared to be in satisfactory condition, no corrective actions are required at this time.
- ☐ c. The dam crest appeared to be in fair to poor condition and requires corrective action.
- ☐ d. The dam crest appeared to be in unsatisfactory condition and not expected to fulfill its intended function. Urgent corrective action is required.

**Corrective Actions:**

- ☒ e. Access along the crest was satisfactory. 0 N FOOT
- ☐ f. Access along the crest was not possible. Description: \_\_\_\_\_
- ☐ g. Rut and/or Gully erosion was observed on the crest, which requires maintenance and/or repair. Description: \_\_\_\_\_
- ☐ h. A crack was observed on the crest, which requires further investigation to determine the underlining cause. Monitor the area and/or repair as required.
- ☐ i. A sinkhole was observed on the crest, which requires further investigation to determine the underlining cause. Repair and monitor the area.
- ☐ j. Portions of the crest were not visible due to high grass and bush vegetation. Clear high vegetation and maintain low to enable easy visual inspection.
- ☐ k. Tree(s) were observed along the dam crest. Trees have been identified as the probably cause of piping failures, and can possibly cause sever damage to the embankment if they are uprooted during a high winds. Corrective action is required to remove the tree hazards from the dam. Acceptable remedies include removal of the tree and its root structure down to a 2" diameter and reconstructing the damaged embankment section. All repair work shall be accomplished as per the requirements of licensed geotechnical or structural engineer. Routinely monitor the damaged area for signs of settlement and seepage.
- ☐ l. \_\_\_\_\_



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NEAR VERT. EST. TO BE 1 ON 20 V  
(Typical Slope  $\pm$  7 )  $\hat{H}$

# 7. Downstream Slope:

NO ACCESS - VERTICAL

Access: ☐ lower roadway along toe ☐ roadway to outlet works ☐ walkway to outlet works ☐ None Observed

Slope Protection: ☐ None ☐ Dumped Rock ☐ Rip Rap ☐ Grouted Rip Rap ☒ Concrete

Erosion: ☐ Loose soil w/ little vegetation ☐ Rut (<6") ☐ Gully (>6" deep) ☐ Not Visible ☒ None Observed

Description: \_\_\_\_\_

Cracks: ☐ Parallel with crest ☐ Perpendicular to crest ☐ Slide visible ☐ Not Visible ☒ None Observed

Description: \_\_\_\_\_

Sinkholes: ☐ \_\_\_\_\_ in. Wide x \_\_\_\_\_ in. Long x \_\_\_\_\_ in. Deep ☐ Not Visible ☒ None Observed

Description: \_\_\_\_\_

Vegetation: ☒ None ☐ Low Ground Cover ☐ Bushes or Tall Grass ☐ Trees # \_\_\_\_\_ ☐ <6" ☐ >6" & <20" ☐ >20"

Description: \_\_\_\_\_

Seepage: Seep Spot Number 1

☐ Green Vegetation ☐ Wet or Muddy Ground ☐ Ponding Water ☐ Not Visible ☒ None Observed

☐ Flowing, Description: \_\_\_\_\_

Water Clarity: ☐ Clear ☐ Some particles ☐ Muddy ☐ Other: \_\_\_\_\_

Description: \_\_\_\_\_

Seep Spot Number 2

☐ Green Vegetation ☐ Wet or Muddy Ground ☐ Ponding Water ☐ Not Visible ☒ None Observed

☐ Flowing, Description: \_\_\_\_\_

Water Clarity: ☐ Clear ☐ Some particles ☐ Muddy ☐ Other: \_\_\_\_\_

Description: \_\_\_\_\_

## Findings:

- ☐ a. The downstream slope was not inspected.
- ☒ b. The downstream slope appeared to be in satisfactory condition, no corrective actions are required at this time.
- ☐ c. The downstream slope appeared to be in fair to poor condition and requires corrective action.
- ☐ d. The downstream slope appeared to be in unsatisfactory condition and not expected to fulfill its intended function. Urgent corrective action is required.

## Corrective Actions:

- ☐ e. Slope protection needs maintenance or repair. Description: \_\_\_\_\_
- ☐ f. Rut and/or Gully erosion was observed on the slope, which requires maintenance and/or repair. Description: \_\_\_\_\_
- ☐ g. A crack was observed on the slope, which requires further investigation to determine the underlining cause. Monitor the area and/or repair as required.
- ☐ h. A sinkhole was observed on the slope, which requires further investigation to determine the underlining cause. Repair and monitor the area.
- ☐ i. The down stream slope was not visible due to high grass and bush vegetation. Clear high vegetation and maintain low to enable easy visual inspection.
- ☐ g. Tree(s) were observed on the downstream slope. Trees have been identified as the probably cause of piping failures, and can possibly cause sever damage to the embankment if they are uprooted during a high winds. Corrective action is required to remove the tree hazards from the dam. Acceptable remedies include removal of the tree and its root structure down to a 2" diameter and reconstructing the damaged embankment section. All repair work shall be accomplished as per the requirements of licensed geotechnical or structural engineer. Routinely monitor the damaged area for signs of settlement and seepage.
- ☐ h. Seepage/Ponding water was observed. Monitor and conduct further investigation to locate the source of water and extent of any possible hazardous or developing condition.
- ☐ i. Seepage was observed flowing and particles were observed to be removed by the flow. Take immediate action to stop the loss of soil from the embankment. Conduct further investigation to determine the underlining cause and take corrective action. Monitor the area.
- ☐ j. The slope was very steep, around a 1 to 1 slope, further study is required to verify slope stability.

- ☒ k. ARCH DAM WAS BUILT PRIOR TO ROUTINE CONSIDERATION OF UPLIFT SEEPAGE FORCES. DAM STABILITY SHOULD BE EVALUATED. NOTE CONVENTIONAL 2D LIMIT EQUILIBRIUM ANALYSIS WILL NOT CAPTURE CRITICAL STABILIZING FORCES OF THE ARCH DAM AT ENDS.

**8. Abutments/Toe:**

Erosion: ☐ Loose soil w/ little vegetation ☐ Rut (<6") ☐ Gully (>6" deep) ☐ Not Visible ☒ None Observed  
 Description: \_\_\_\_\_

Cracks: ☐ Parallel with crest ☐ Perpendicular to crest ☐ Slide visible ☐ Not Visible ☒ None Observed  
 Description: \_\_\_\_\_

Vegetation: ☐ None ☒ Low Ground Cover ☐ Bushes or Tall Grass ☐ Trees # \_\_\_\_\_ ☐ <6" ☐ >6" & <20" ☐ >20"  
 Description: \_\_\_\_\_

Seepage: Seep Spot Number 1  
☐ Green Vegetation ☐ Wet or Muddy Ground ☐ Ponding Water ☐ Not Visible ☐ None Observed  
☒ Flowing, Description: SLIGHT CONSTANT FLOW @ RIGHT ABUTMENT / TOE  
 Water Clarity: ☒ Clear ☐ Some particles ☐ Muddy ☐ Other: LESS THAN 1 GPM  
 Description: SEEP WAS CLEAR AND APPEARS TO HAVE BEEN FLOWING FOR A LONG TIME BASED ON STAINING OF ROCK AT SEEP.

Seep Spot Number 2  
☐ Green Vegetation ☐ Wet or Muddy Ground ☐ Ponding Water ☐ Not Visible ☒ None Observed  
☐ Flowing, Description: \_\_\_\_\_  
 Water Clarity: ☐ Clear ☐ Some particles ☐ Muddy ☐ Other: \_\_\_\_\_  
 Description: \_\_\_\_\_

**Findings:**

- ☐ a. The abutments/toe were not inspected.
- ☐ b. The abutments/toe appeared to be in satisfactory condition, no corrective actions are required at this time.
- ☒ c. The abutments/toe appeared to be in fair to poor condition and requires corrective action. (SEEP SHOULD BE EVALUATED FURTHER)
- ☐ d. The abutments/toe appeared to be in unsatisfactory condition and not expected to fulfill its intended function. Urgent corrective action is required.

**Corrective Actions:**

- ☐ e. Slope protection needs maintenance or repair. Description: \_\_\_\_\_
- ☐ f. Rut and/or Gully erosion was observed, which requires maintenance and/or repair.  
 Description: \_\_\_\_\_
- ☐ g. A crack was observed along the abutments/near the toe, which requires further investigation to determine the underlining cause. Monitor the area and/or repair as required.
- ☐ h. The abutment/toe area was not visible due to high grass and bush vegetation. Clear high vegetation and maintain low to enable easy visual inspection.
- ☐ i. Tree(s) were observed along the abutment/toe. Trees have been identified as the probably cause of piping failures, and can possibly cause sever damage to the embankment if they are uprooted during a high winds. Corrective action is required to remove the tree hazards from the dam. Acceptable remedies include removal of the tree and its root structure down to a 2" diameter and reconstructing the damaged embankment section. All repair work shall be accomplished as per the requirements of licensed geotechnical or structural engineer. Routinely monitor the damaged area for signs of settlement and seepage.
- ☒ j. Seepage/Ponding water was observed. Monitor and conduct further investigation to locate the source of water and extent of any possible hazardous or developing condition.
- ☐ k. Seepage was observed flowing and particles were observed to be removed by the flow. Take immediate action to stop the loss of soil from the embankment. Conduct further investigation to determine the underlining cause and take corrective action. Monitor the area.
- ☐ l. \_\_\_\_\_

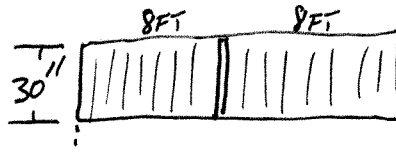
Dam ID: MA-0046

WAIKAMOI DAM NO. 2

Inspection No: \_\_\_\_\_

Date: 4/5/06

OUTLET



9. Outlet Works:

Culvert / Pipe

Type / Size: 16 FT X 30" +

Culvert: ☒ Concrete ☐ Masonry ☐ unlined earth ☐ Other \_\_\_\_\_

Pipe: ☐ DIP ☐ Corrugated Metal ☐ PVC ☐ HDPE ☐ Concrete ☐ Other \_\_\_\_\_

Control Type: ☐ Gate ☐ Valve ☒ Other NONE (GEOMETRY ONLY)

Location: ☐ Control on Upstream side ☐ Control on Downstream side N/A

Seepage: ☐ Green Vegetation ☐ Wet or Muddy Ground ☐ Ponding Water ☐ Not Visible ☒ None Observed

Flowing, Description: \_\_\_\_\_

Water Clarity: ☐ Clear ☐ Some particles ☐ Muddy ☐ Other: \_\_\_\_\_

Description: \_\_\_\_\_

Findings:

- ☒ a. The outlet works were not inspected. - ACCESS DIFFICULT, BUT APPEARED TO BE WORKING AS DESIGNED.
- ☐ b. The outlet works were not tested.
- ☐ c. The outlet works appeared to be in satisfactory condition, no corrective actions are required at this time.
- ☐ d. The outlet works appeared to be in fair to poor condition and requires corrective action.
- ☐ e. The outlet works appeared to be in unsatisfactory condition and not expected to fulfill its intended function. Urgent corrective action is required.

Corrective Actions:

- ☐ f. Seepage/Ponding water was observed. Conduct further investigation to locate the source of water and extent of any possible hazardous or developing condition.
- ☐ g. Seepage was observed flowing and particles were observed to be removed by the flow. Take immediate action to stop the loss of soil. Conduct further investigation to determine the underlining cause and take corrective action. Monitor the area. Failures caused by seepage/piping along the outlet conduit are very common and are considered to be a dangerous situation.
- ☐ h. Were not visible due to high grass and bush vegetation. Clear high vegetation and maintain low to enable easy visual inspection.
- ☐ i. \_\_\_\_\_
- ☐ j. \_\_\_\_\_

**10. Spillway:**

Type: ☐ None ☐ Culvert/Pipe ☒ Channel  
Description: CONCRETE FLIP BUCKET TYPE, VERY STEEP  
Dimension: ≈ 15 ft. Invert elevation: UNKNOWN ft. per staff gage  
Slope Protection: ☐ None ☐ Grass ☐ Dumped Rock ☐ Fitted Rip Rap ☐ Grouted Rip Rap ☒ Concrete  
☐ Defect in Protection: Description: \_\_\_\_\_  
Approach: ☒ Clear ☐ High Veg. ☐ Trees ☐ Other: \_\_\_\_\_  
Erosion: ☐ Scour ☐ Gully ☐ Headcut ☒ Not Observed ☐ Other: \_\_\_\_\_  
Description: \_\_\_\_\_  
Vegetation: ☒ None ☐ Low Ground Cover ☐ Bushes or Tall Grass ☐ Trees # \_\_\_\_\_ ☐ <6" ☐ >6" & <20" ☐ >20"  
Description: \_\_\_\_\_

**Findings:**

- ☒ a. The Spillway appeared to be in satisfactory condition, no corrective actions are required at this time.  
☐ b. The Spillway appeared to be in fair to poor condition and requires corrective action.  
☐ c. The Spillway appeared to be in unsatisfactory condition and not expected to fulfill its intended function. Urgent corrective action is required.

**Corrective Actions:**

- ☐ d. Slope protection needs maintenance or repair. Description: \_\_\_\_\_  
☐ e. The spillway approach was blocked. Clear approach.  
☐ f. Severe scour erosion was observed which requires maintenance and/or repair.  
Description: \_\_\_\_\_  
☐ g. A headcut (vertical drop in channel due to erosion) was observed downstream of the spillway. Corrective action is required to prevent this problem from moving upstream.  
☐ h. Trees are unacceptable in the spillway channel and approach. Take corrective action to address the woody vegetation problem and repair the damaged area.  
☐ i. Unclear if spillway is adequately sized. Spillway should pass the probable maximum flood. Verify spillway capacity and take corrective action as required.  
☐ j. \_\_\_\_\_

**11. Down Stream Channel:**

Name: NONE  
Downstream: ☐ Sump ☐ Open Area ☐ Un-Defined Drainage-way ☒ Defined Drainage-way ☐ Other ROCK VALLEY  
Items along Stream Bank: ☒ None ☐ Road ☐ Houses ☐ Town ☐ Not Inspected  
Description: FLOWED DS TO OUTLET

**Findings:**

- ☒ a. The downstream channel was not inspected.  
☐ b. The downstream channel appeared to be in satisfactory condition, no corrective actions are required at this time.  
☐ c. The downstream channel appeared to be in fair to poor condition and requires corrective action.  
☐ d. The downstream channel appeared to be in unsatisfactory condition and not expected to fulfill its intended function. Urgent corrective action is required.

**Corrective Actions:**

- ☐ e. \_\_\_\_\_

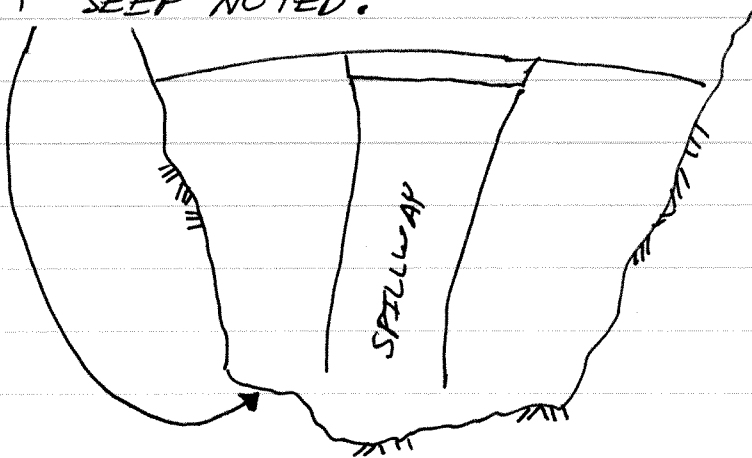
**Additional Comments:**

On the date of this limited visual inspection, there appeared to be no immediate threat to the safety of the dam. No assurance can be made regarding the dam's condition after this date. Subsequent adverse weather and other factors may affect the dam's condition.

1) BASED ON VISUAL OBSERVATIONS AND DISCUSSION OF OPERATIONAL PROCEDURES OF THE DAM, THERE IS NO IMMEDIATE THREAT TO THE SAFETY OF THE DAM AT THIS TIME.

2) THE ARCH DAM WAS BUILT PRIOR TO THE ROUTINE CONSIDERATION OF UPLIFT SEEPAGE FORCES. DAM STABILITY SHOULD BE EVALUATED BASED ON CURRENT CRITERIA.

3) SLIGHT SEEP NOTED.

**Limitations and Intent of this Dam Safety Inspection:**

This Dam Safety Inspection was conducted to assess the general overall condition of the reservoir/dam, identify visible deficiencies, and recommend areas of for monitoring, additional investigative studies and corrective actions. The inspection is based only on visible features/areas of the dam on the day of inspection. This inspection is not a formal phase I or phase II dam safety inspection and does not include a review or evaluation from each specialist of an inspection team, such as a geologists, civil, geotechnical, structural, or hydraulics engineer. The owner should verify the findings of this report and take corrective actions. The owner may submit to the State alternative corrective actions that are certified by a licensed professional engineer in the State of Hawaii experienced in the design and construction of dams. This inspection does not relieve the owner/operator from their responsibility to conduct routine inspections, maintenance, repairs, modifications, monitoring, documentation, and/or investigative studies. The inspection was conducted under the authority of the Hawaii Revised Statutes Chapter 179D, and Hawaii Administrative Rules, Title 13, Chapter 190, titled "Dams and Reservoirs". Questions regarding this inspection should be forwarded to the Hawaii State Dam Safety Program; PO Box 373; Honolulu, Hawaii 96809; Ph. (808) 587-0236.